Pre Ph.D.-Synopsis

Study of plant diversity in forest hotspots of Nanded district of Maharashtra and their environmental significance by using Remote sensing and GIS techniques.

In the subject of
Environmental Sciences.

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Abstract:

Plants diversity play an important role and will continue to play major role in shaping the world's civilization (Yadav & Sardesai, 2002). Cultural, economic and overall development of a particular region is largely depending on the careful exploration, utilization as well as conservation of its natural resources. Therefore, assessment and documentation of biodiversity have become an urgent need of the day.

In the present investigation, biodiversity studies & digital information of plant diversity in selected forest hotspots of Nanded district of Maharashtra by using Remote sensing and GIS techniques will be assessed, and alongwith this I) Study land use and Land cover changes detection, II) Change in cropping pattern in and around selected forest hotspots, iii) Evaluation of soil samples from selected forest hotspots from study area will be done.

Nanded forest division has a good deciduous forest hotpots and it is only available in Bhokar taluka (Sitakhandi forest area), Hadgaon taluka (Kedarguda forest area), Kinwat and Mahur talukas. The detailed biodiversity studies and digital documentation of the study area will be done in the present investigation. The degradation of the forest trees along the Kinwat-Mahur forest area, Sitakhandi forest area and Kedarguda forest area will be analysed by using remote sensing data available from NRSC (National Remote Sensing Centres) Regional Centres. The detailed analysis will be done by using Various GIS techniques and various remedial measures will be suggested for improving the forest resources.

Keywords: Plant diversity, selected forest hotspots, Nanded district, NRSC (National Remote Sensing Centres), Remote sensing, GIS techniques, Tribal studies Etc.

1) Introduction:

The biodiversity is defined as the variety and variability among living organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; Biodiversity refers to the range of variations among a set of entities and is commonly used to describe variety and variability of living organisms in terms of genetic diversity (heritable variations within populations), species diversity (species richness in a habitat) and ecological diversity (biophysical diversity). (Marie, 2016; Patel and Patel, 2021).

Digitization is the process of converting information into a digital format. Digitizing information makes it easier to preserve, access, and share. For example, A specific plant from a particular location may only be accessible to people who visit its exact location, but if the document content is digitized with the help of various digitizing process for. e. g. using GPS and GIS systems, it can be made available to people worldwide. There is a growing trend towards digitization of historically and culturally significant areas in the country. Number of such premises has been studied by various workers. (Khadri *et. al.* 2015)

India, because of its unique biogeographic location embraces three major biological realms, viz. Indo-Malayan, Eurasian and Afro-tropical. It is notable in its species-richness and endemism, and is ranked tenth amongst the biodiversity- rich countries. India is one of the world's 12 Vavilovian centres of origin and diversification of cultivated plants (with 167 species of agri horticultural crops and 320 species of their relatives known to have originated here). Conservative estimates of species-richness show that around 127,000 species (plants, animals and microorganisms) have been so far reported from India and 400,000 species are yet to be explored. Conservation of biodiversity is important to mankind for various reasons. It facilitates ecosystem functions (carbon exchange, watershed flows, soil fertility, climate, etc.), offers aesthetic, scientific, cultural and other values and forms the basis for foodstuff, fibers, pharmaceuticals, chemicals, etc. (Desavathu *et. al* 2018).

मराठवाडा विद्यापीठ, नांदेड

Forests are the most valuable natural resources available to the mankind on planet earth. On the one hand, they are the essential source of livelihood for the poor and marginalized section of the society; on the other hand, they provide furniture and other items of desire for the rich. To reverse the degradation in resources, action programs for conservation and development of forest resource have taken shape in most of the countries. Rapid deforestation has added to the excess heat on earth. World community especially the political leadership and intellectual class in the

developing countries should act and take mitigating steps to control the global warming. The protective and productive role of forests in this regard assumes importance (Desavathu *et. al.* 2018).

Forest plays an important role in the water cycle, carbon sequestering, as a genetic bank and source of food; they stimulate rainfall, protect soils from erosion and regulate the flow of water. Tropical forests are disappearing fast while the number of people depending on them grows steadily. It is worthy of note that as environmental services are degraded and users become affected, people become more environmentally conscious and will want to protect the environment. (Desavathu et. al 2018).

Biodiversity of forest resource can sustain lives as people depend on it for livelihood, and conservation of forest resources is development as ecotourism generates income. But then again, biodiversity conservation is now considered critical to the attainment of sustainable development as the world population collectively contribute to the degradation of the natural resource base like the forest. The USAID (United States Agency for International Development) estimated a biodiversity loss of 1,000 species going extinct each year due to uncontrollable legal and illegal human activities. (Patel and Patel, 2021)

1.1 Scope of study: -

An understanding of the distribution of plants and their species in a region plays an important role in elucidating the larger patterns of distribution of biodiversity. Present investigation will be very important as it will be helpful for plant diversity in selected forest hotspots of Nanded district of Maharashtra which will be more helpful for the students and researchers. Documentation of existing plant diversity selected forest hotspots in the study area from Nanded district of Maharashtra is important to determine existing resources and to set target for future improvements. Floras serve as the basic reference of the plant biota of an area; they are critical tools that serve botanists, conservationists, ecologists, foresters, gardeners, agronomists, researchers, and the public. The botanical exploration of the study area will be helpful to provide economically valuable information for societal need.

1.2 Aims and Objectives of the study:

Following are the aims and objectives of the present investigation: -

1) **To study or explore the plant diversity in selected forest hotspots of Nanded district of Maharashtra.**

2) **To obtain the digital information of plant diversity in selected forest hotspots of Nanded district of Maharashtra.**
3) **To study the change in cropping pattern in and around (forest fringe areas) selected forest hotspots of Nanded district of Maharashtra.**
4) **To study the density and distribution of plant diversity in selected forest hotspots of Nanded district of Maharashtra by using statistical methods and GIS technology.**
5) **To study land use and Land cover change detection in selected forest hotspots of Nanded district of Maharashtra.**
6) **Evaluation of soil samples from selected forest hotspots of Nanded district of Maharashtra.**
7) **To study the remedial measures for declining plant diversity in selected forest hotspots in Nanded district of Maharashtra.**

2) Review and Literature:

The floristic diversity in India and abroad was carried out by many workers (Lass and Callihan, 1993; Kulkarni, 2000; Turner et. al, 2003; Theller and Engel,2004; Ali, 2006; Ghate and Datar, 2009; Keita, N. *et. al.* 2010; Memon *et. al*,2011; Karayel et. al. 2012; Nagrajan and Gupta,2013; Raskar and Pawar, 2014; Sahu *et. al*., 2015; Shrivastava, 2016; Srivastava and Anitha, 2010; Wankhede and Mulani, 2016.) in which remote sensing and GIS applications have been applied. Few of such references are given here in detail,

Eludoyin *et al*., (2011) The study assesses the spatio-temporal land use and land cover changes between 1986 and 2000. The land use types include farmland, built up area, water, sparse vegetation, primary forest, secondary forest and mangrove. The area in square kilometers of each land use type in each year was calculated and thereafter the change was determined by subtracting the area of the same land use type in 1986 from 2000 and the percentage of change is therefore calculated. In addition, the probability of change of twenty years was also determined from one land use type to another using Markovian Transition Estimator (MTE) from IDRISI Andes. The study reveals that farmland, mangrove, primary forest and sparse vegetation reduced. while secondary forest, built up area and water increased. It is recommended among others that laws should be promulgated to prevent unlawful expansion of construction of any form and that the people in the communities in the study area should be enlightened and educated on the effects of deforestation on the environment.

Yannwar *et. al.* (2013) analyzed the expansion of urbanized areas of Nanded between 1990 and 2012, based on comparison of old topographic sheets, recent satellite images and other

similar information of the intervening years. A digital and visual-based classification method is applied to find out the areal extent of the city. It is found that main conversion has taken place from agriculture land to built-up land and road networks. This growth is subsequently discussed with levels of development, with focus on unplanned nature of growth of Nanded city.

Kacic and Kuenzer (2022) gave review which presents a comprehensive analysis on forest biodiversity based on spectral diversity from airborne and spaceborne remote sensing. Notable progress was made regarding the development of statistical concepts and the growing number of complementary sensors integrated.

Lass and Callihan (1993) introduced use of GPS and GIS for weed surveys and management. He showed Global positioning systems can record site and boundary data directly in the field and when linked with geographic information system could transfer those data to computerized equipment to compile and generate maps and other data sets. They investigated about recognized advantages of GPS and GIS system for weed surveys and management.

The accuracy of single point readings is measured with accurate statistical data. It also showed its ability to accurately record the boundaries of an infestation by weeds in a particular area. They have also showed the ability of GPS and GIS system to give accurate position infested by weeds in relation to other known physiographic map features like border area, roads, trails, streams, soil types. GPS and GIS are useful location methods for weed management planning with 1 meter accuracy. The integration and combination of GPS data with GIS data gives precise mapping of weed surveys and provides information accurate enough to enable its use in weed management technologies.

Kulkarni (2000) investigated it global positioning system and its applications. he had demonstrated various features, background, segments of GPS system with principle of operation methods of observation with GPS for surveying also demonstrated which includes absolute positioning, relative positioning, differential positioning and kinematic GPS. Various applications of GPS such as high accuracy, versatility, easy to use and economy of operation, all weather operations such as rain falls, storms, drought, flood etc. It had found numerous applications in many fields ranging from the millimeter level eye precisions.

Semwal and Ahlawat (2002) studied applications of geoinformatics in plant Genetic resource studies. During these investigations they showed the applications of geoinformatics technology in Plant Resource Management (PGR). This technology ensures integrated approach to use geospatial technologies (Remote sensing, Geographic Information System, Global Positioning System) in precise way to map, quantify and predict agrobiodiversity rich areas beside other applications in agricultural sectors. Geo-coordinates (Latitude and Longitude) recorded by

Global Positioning System which is used in Geo referencing and diversity distribution mapping, Geoinformatics tools and crop models have been used in diversity distribution mapping and predicting suitable sites for future collection. Present use and future prospects of Geoinformatics in Genetic resource studies are shown by them.

Kaiser, *et.al.* (2003) studied the application of Geographic information system and Global positioning system in Humanitarian Emergencies. He showed recent areas of application of GIS and GPS method in humanitarian emergencies which include hazard, vulnerability and risk assessment, and survey methods, disease distribution and outbreak investigations, planning and implementation of health information system and programmed monitoring and evolution. He shown the use of GIS to provide map and improved data collection.

They were presented applications of GIS for NGOs, Government organizations for quick response in any hazardous condition. It is more user friendly, cheap in cost and more and more humanitarian welfare organizations will incorporate it in their modernize technique for better monitoring and evolution.

Turner *et. al.* (2003) explained various applications of Remote sensing technology for betterment of biodiversity of science and conservation. In modern era rapid biodiversity decline due to various factors is seen. They also showed various applications of Remote sensing for (1) Primary productivity for species richness. (2) Climate variables to species distribution by remote sensing. (3) Remote sensing of habitat structure and topography. One of the most important applications of remote sensing is for biodiversity conservation is the detection of and mapping of various invasive species. Best example Theodore Roosevelt National Park of Western North Dakota, USA successfully detected intentions of leafy spurge *Euphorbia esula* using three hyperspectral sensors at three separate ground spatial resolutions.

Theller and Engel (2004), presented an overview on Global positioning system and Geographical information System (GIS). They were demonstrated work in and architecture of GPS and GIS as a benefit to plant biosecurity management. They also showed techniques about preparing various maps, models and database for strengthening plant bio security by using GPS and GIS for e.g., plant disease epidemic in a small area could be handled by management of using GPS and GIS software.

Ali (2006) investigated about mapping vegetation cover using remote sensing and mobile GIS Punjab University Lahore, Pakistan. He had surveyed vegetation mapping cover of Punjab University by using mobile GIS in which he used ArcGIS software and tree locations spatial distribution and clustering pattern of tree with areas of high and low clustering.

Keita, N. et. al. (2010) suggested issues and guidelines for the emerging use of GPS and

PDAs in agricultural statistics in developing countries. He showed the use of handheld geo-referencing devices (Global positioning and personal data assistant equipped with GPS) emerging as an effective means of reducing the cost of crop area data collection and improving crop area data quality. In many developing countries collecting reliable data on crop area still remain challenge. The result of survey clearly showed that improving the methodologies for estimation of crop area, yield, and production. He also showed the limitations of present methodologies of data collection of crop yield and showed steps to follow for using GPS and PDAs for crop area measurement. He had recommended use of GPS and PDAs for crop area measurement and use of Georeferencing data collection for crop area measurement.

Kulkarni and Banerjee (2011) suggested about renewable energy sources mapping in Maharashtra using GIS. They indicated increasing negative effect of fossil fuel in addition to limited stock and instead of these use of renewable energy resources. Their study was focused on mapping on potential sites for trapping renewable energy sources. They used open-source software QUANTUM GIS (QGIS) used to analyze variability of renewable energy. Spatial interpolation was done for micro analysis to define the usefulness of the system.

A framework was developed for mapping renewable energy resources using an open domain GIS (QGIS), using this framework it is possible to determine average wind and solar energy densities in selected regions. This was illustrated for Maharashtra state in India. The framework developed can be used to assess deriving decisions. For other states and countries Quantum GIS Framework could be useful for renewable power generation deriving and planning for any region as QGIS is an open domain software framework.

Memon *et.al.* (2011) conducted study in the fields of Khairpur district, Sindh, Pakistan for the mapping of some important weeds of wheat and cotton by using geographic information system (GIS). They prepared base map of Khairpur district, Sindh, Pakistan indicating the sampling sites and physical features of the area and also two more maps were also created to show the density and frequency of weeds of wheat and cotton crops in each area with forms of bar and pie diagram data. The study was conducted during 1999-2000 for the surveying and mapping of wheat and cotton weeds using GPS and GIS technology in khairpur district. Field sampling was done by choosing four sampling sites randomly from each taluka. Five quadrates of one meter square were selected from each site to collect the data of each weed species. Location coordinates were recorded with GPS and were downloaded into GIS software to create detailed maps. ArcView GIS 3.1 version a computerized mapping system was used to prepare GIS database. In order to create maps, the collected information of all weed species transferred into ArcView GIS software version3.1 to create maps and allows for quick reference and printing.

Karayel *et. al.* (2012) investigated about use of global positioning system and real time kinematic for the determination of seedling distributions over the field. In present investigation the potential use of real time, kinematic (RTK) and global positioning system to determine seed and plant growing area mapping could potentially use in the evaluating used to control plant specific crop management. Actual plant locations were obtained by RTK and GPS. During this investigation in about 0.5-hectare area study was carried out on the seedlings of 750 specimens of Soybean, Cotton, Watermelon for the analysis of deviation between plant positions, growing area and shape ratio by using RTK GPS system and tape meter (for actual locations).

By using Real Time Kinematic (RTK) Global positioning System (GPS) generated a millimeter accuracy Soybean, Cotton, Watermelon plant maps. The mean distance between RTK GPS generated map location and the actual plant locations measured by tape meter (Tape measurement) was less than 10 mm. The differences between plant growing area and shape ratio obtained from RTK GPS system and actual GPS coordinates were not significant for all plants. The shape ratio was not useful for closely spaced plants. Hence the use of RTK GPS system generated useful data of plant characteristics is important. Hence it can successfully replace manual measurement techniques i.e. tape measurement technique.

Nagrajan and Gupta (2013) conducted a study to prepare a brief development plan based upon extensive primary survey of the village "Potheri" in Kancheepuram district, Tamilnadu, India and its environment by using the technique of GPS, GIS system and with the help of DBMS Language. Handheld GPS instrument (1 Mtr. Accuracy). The GPS coordinate points (lattitue & longitude) used to collect data of objects (houses, tubewells, street lights, roads,) and converted them into shape files and accessed with the help of GIS. The additional information of the village with each and every feature collected separately from different sources and attached with existing taken GPS data through ArcGIS software. The personal Geodatabase is converted into shape files by using conversion tool in ArcGIS. The information system was created in terms of house number, owner name, latitude, longitude, address etc. With the help of this GIS system modification like updating and deleting data can be easily done. This system will be very much helpful for the local authority such as municipality, post office, electricity board.

Raskar and Pawar (2014) suggested about crop planning for food and nutrition security using GIS and mobile GPS technology. Their main objective was to promote dietary diversification to achive a balanced intake of all micronutrients for diet needs of the family. Ghoti village in Ahmednagar district, Maharashtra was the case study area which was under agroclimatic transition zone. Due to uncontrolled events of climate such as rainfall, cold wave and drought which ultimately damage the crop. They made an attempt of crop planning at home

level by using GIS technology which could be useful and maintained balance between not only agricultural production for sale of the crop in the market but also food consumption for home purpose. They used Esri ArcGIS software version 10.2 for mapping agricultural plots and by using Georeferenced Cartosat image (2.5 m resolution). The agricultural plots were identified by using mobile GPS based ArcPad software during crop mapping in the field.

Sahu *et. al.* (2015) studied about high resolution remote sensing, GPS and GIS applications in soil resource mapping and characterization. They studied timely and reliable information on soils with respect to their nature, extent, spatial distribution is very crucial for optimal utilization of available natural resources on a sustained basis. They showed the integrated us of advanced computer technologies with database can be used to assist decision makers for future plans. Utilization of high-resolution satellite data by using remote sensing, GPS and GIS system could be utilized for deriving the spatial, temporal agricultural information at micro level. For sustainable development of specific region could be possible by satellite derived spatial data, ground observation, non-spatial attribute data in remote sensing, GPS and GIS environment would be highly desirable. Their review on application of high-resolution remote sensing data in combination with GPS and GIS shows that soil resource mapping and their characterization in cost and time effective processes.

Shinde *et. al.* (2016) analyzed GIS based mapping for ground water quality in southern part of Aurangabad city, Maharashtra, India. The main objective of the study was to analyze groundwater contamination due to anthropogenic activity (Human activity) using Geographical Information System (GIS). In six villages of ten Aurangabad and Gangapur taluka beside Waluj MIDC of the southern part of Aurangabad city, Maharashtra, India the impact of the river water contamination of Ground water contamination was investigated and reported by authors. The benefits of GIS system are data capturing and processing a particular data, it also gives facility of powerful computational tool that facilitate multi-map investigation.

They collected water samples from 40 dug wells on the either side of the Kham River which represents entire agricultural area of the study site. Physical and chemical parameters of the water samples such as pH, Ec, TDS, CL, NO_3, were analyzed systematically during pre-monsoon and post monsoon. The contaminated ground water is due to infiltration of the waste water in adjacent areas. GIS technology can provide accurate platform for convergent analysis of large amount of multidisciplinary data and decision making for effective ground water study.

Mulani and Wankhade (2016) carried out an investigation on digitization of leguminosae tree plants from Kinwat and Mahur forest ranges of Nanded district in Maharashtra by using morphological information of the plant, taxonomically important photographs and

ethnomedicinal uses along with other information related to the plant. Hyperlink computer technique was used while doing the digitization. During investigation Digitization was carried out by using plant features like ethnomedicinal uses, morphological information of the plants along with other importance were also summarized. The digitization of plant gives instant global access to the plant information and easy to maintain and process this information.

According to the researchers Digitization work was useful for the leguminosae tree plants identification, and teaching taxon recognition. It was also provided the useful information related to the species. It was also provided the ecological information of the species. It was improved the collection and preservation techniques of the plant specimen. It gave global access to the plant information and also made it easy to process this information. This digitization technology could be useful for opening the new research opportunities in plant sciences.

Shrivasatava and Anitha (2016) studied on mapping of Non timber forest products (NTFP) using remote sensing and GIS. In present investigation research attempt had been made to develop new method to map NTFP products by using satellite remote sensing and GIS. The satellite data was used to generate a forest type map, forest density map, non-timber forest map and map showing total economic values of trees in Pune district, Maharashtra, India. These maps were investigated in GIS system to generate a NTFP map. The result indicated that non timber trees having moderate to high total economic value (TEV) dominated the western subtropical broad leaf hill forest located in difficult terrain and away from human settlements.

Eight different land cover types were identified within the district using imagery which included five forest types, covering 18.2 % of the area. They were also generated forest density map. They indicated the distribution of tree species depends not only on the ecology of the area but also on the anthropogenic pressure.

Srivastava (2016) presented a report about application of GIS and remote sensing for forest conservation. According to Maharashtra Forest department (MFD) digitized all the forest area with the introduction of GPS, GIS and remote sensing technology in MFD. Forest guards who were before using the hard copy of maps of the various areas of the forest are now using PDAs and various gadgets to update the information online. Extensive use of digital technologies such as GIS, GPS and remote sensing to ensure field officials are provided with accurate data sets. This helped in smooth coordination and functioning between MFD and various government departments for better results in various activities for ensuring the success of initiative. MFD is collaborating with all other administrative departments of Maharashtra government. Now MFD had GIS based mobile application to monitor the saplings, to monitor the forest cover change periodically and ultimately the same data is uploaded on the geoportal. There are 6400 PDA

devices for officials to get accurate data sets for better implementation of their day-to-day decision making.

Thus, it is concluded that GIS and Remote sensing technology can be effectively used for planning, monitoring, and assessment of the need of crop planning for food and nutrition security at home level. We have carried out diversity and distribution of plant species as algae, fungi, and higher plants some work in the campus of SRTM University **Nanded**. [Mulani, *et. al*. (2015), Mulani and Wakode (2015); Mulani and Pawar (2015): Mulani, 2022)].

3) Methodology:

1) Initially the forest hotspots will be selected from forest area of Nanded district of Maharashtra and visited during the study.
2) Taxonomical survey of the plant species occur in selected forest hotspots of Nanded district of Maharashtra will be done by regular visits to various locations to find out the flowering and fruiting season.
3) Digital documentation of plant species will be obtained by using remote sensing, GPS and digital camera.
4) The soil analysis of various sites from study area will be studied in the laboratory by using Standard methods.
5) Ethnomedicinal information will be procured from local tribal people, herbal practitioners and local Vaidas and information available in the literature.
6) The digital data will be analyzed by using available remote sensing, GIS techniques, statistical tools and modern software's.

Selected forest hotspots will be visited every season frequently to check out change in plant diversity. Apart from the morphological observation, soil samples will also be taken from each selected area and it will be analysed by using standard methods. Extensive filed survey will be undertaken to selected forest hotspots of Nanded district of Maharashtra. With the help of Global Positioning Systems (GPS) all visited site area and Quadrate shall be marked. Photos will be taken by using the photo graphic camera for identification of the specimens.

3.1 Quadrate method:

Quadrates will be drawn as per the suitable locations of plant diversity in selected forest hotspots. Mark a 10 m square plot will be made by using the GPS instrument and within each plot available trees will be counted and small subplots for 1 m x 1 m will be used for seedlings and

saplings. Counting the numbers of trees within the plot. Methodology for estimating plant diversity and land cover will be done by using GPS and remote sensing data. The methodology adopted for checking plant diversity and land cover forest area will be estimated by satellite imageries and Ground truthing is carried out in the field by using GPS instrument. Remote sensed data is matched with actual ground realities.

3.2 Study area: -

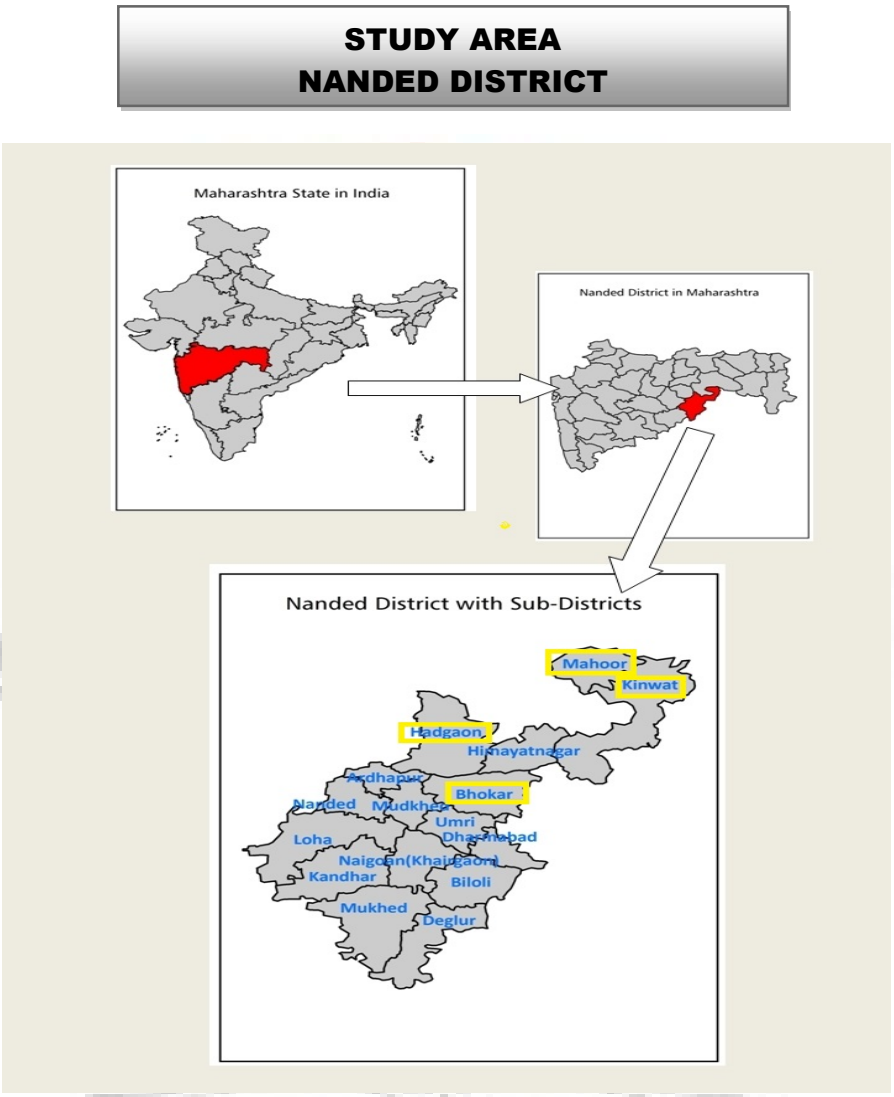
Nanded District lies in the Godavari basin, in the south-eastern part of the State. It is situated between 18º 16' to 19º 55' north latitudes and 76º 56' to 78º 22' east longitudes. It is surrounded by Yavatmal District to the north, Andhra Pradesh State to the east, Karnataka State to the south, Latur District to the southwest and Parbhani and Hingoli Districts to the west. The district has an area of 10,528 Sq. kms., and a population of 33,61,292 persons as per 2011 Census. While the area of the district accounts for 3.42 percent of the total area of the State. The district population constitutes 2.99 percent of the total population of the State. The density of population is 319 persons per Sq. km. Among the 35 districts of the State, the district ranks 11 th in terms of area, 11th in terms of population and 14th in terms of density. (Maharashtra fact check information book of Nanded district 2018).

Nanded district falls under the Eastern Plateau micro region of the Deccan Plateau. Since local relief and other characteristics the district can be grouped into 5 sub-micro level divisions i.e.1) Mukhed-Deglur Plateau, 2) Godavari Basin, 3) Bhokar Plateau, 4) Satmala and Nirmal Hills and 5) Penganga Valley. Bhokar Plateau covers parts of Hadgaon, Himayatnagar and Bhokar Tahsils. This plateau has an altitude varying between 400 and 550 meters and makes the water divide between the Godavari and the Penganga rivers. It is partly covered with dry mixed deciduous forests. The surface is stony in nature and the soils are thin. However, Jowar, Tur, Cotton, Sugarcane and in patches, Bananas are grown. (Maharashtra fact check information book of Nanded district 2018).

Nirmal Hills are in the southern part of Kinwat Tahsil while Satmala Hills are located in Mahoor and the northern part of Kinwat Tahsil. These hills are also known as Bhag or Thanvari or Kinwat Hills. These hills attain elevations varying between 450 and 600 meters. As per census 2011, Forest Cover of Nanded district is about 8.68% of Total Geographical Area. Most parts of these hills are covered by forests, which belong to dry mixed deciduous type of forests. The most valuable species found in this forest is teak. Other species found are bamboo, dhawada, babul and grass. (Maharashtra fact check information book of Nanded district 2018).

Kinwat and Mahur taluka of Nanded districts has old heritage of medicinal plants and herbal medicine. Forest is rich in biodiversity and consists of rare medicinal plants.

Biogeographical condition such as altitude, soil type and average rain fall make the vegetation diversity in this area. (Wankhade and Mulani 2016).



(Source: Maharashtra fact check information book of Nanded district 2018)

3.3 Tribal Population in Nanded district:

Mostly the selected forest areas were dominated by tribal populations which are directly dependent on forest resources of forest fringe villages. The available literature gives the data about the tribal population available in the Nanded district mainly, Schedule Tribe Population 2,81,695 (Persons), 1,43,892 (Males), 1,37,803 (Females), Percentage of ST in total population (2.68) major schedule tribe population Andh (31.09%); Koli Mahadev, Dongar Koli (26.84%); Kolam, Mannervarlu (20.56%); Gond, Rajgond, Arakh, Arrakh, Agaria, Asur, Badi Maria, Bada

Maria, Bhatola, Bhimma, Bhuta, Koilabhuta, Koilabhuti, Bhar, Bisonhorn Maria,Chota Maria, Dandami Maria, Dhuru, Dhurwa, Dhoba, Dhulia, Dorla, Gaiki, Gatta, Gatti, Gaita, Gond Gowari, Hill Maria, Kandra, Kalanga, Khatola, Koitar, Koya, Khirwar,Khirwara, Kucha Maria, Kuchaki, Maria, Madia, Maria, Mana and Manne (Reddy *et. al.* (2019) (Maharashtra fact check information book of Nanded district, 2018).

Due to overexploitation of trees by the villagers for their daily needs like fuelwood, wood for house construction and due to introduction of new species has resulted in declining the native species along the forest fringe areas. In this scenario there is urgent need of conservation of native species by forest department, local people and tribals for multiplication of valuable useful medicinal trees. (Reddy et. al. (2019). (Maharashtra fact check information book of Nanded district, 2018).

3.4 Remote sensing and GIS Techniques: -

Remote sensing is the science and art of acquiring information about an object, area, or phenomena through the analysis of data obtained by a device that is not in contact with the target under investigation. Or it may be defined as the process of obtaining information about land, water or an object without any physical contact between the sensor and the subject under observation (Remote – Not in contact with an object and Sensing – Getting information). Or it is the assessment or acquisition of information of some property of an object or phenomena by a recording device that is not in physical or intimate contact with the object or phenomena under study. Remote sensing is a multidisciplinary approach which comprises of different sciences such as, optics, spectroscopy, computer, satellite launching, photography and electronics. Basic knowledge of all these sciences is very essential and it is being exploited in applications of remote sensing.

Remote sensing procedure involves an interaction between incident radiation and the targets of interest. This is exemplified by the use of imaging systems where the following seven elements are involved (fig.1) 1). Energy Source or Illumination (A): The first necessity for remote sensing is to have an energy source which illuminates or provides electromagnetic energy to the target of interest. 2.) Radiation and the Atmosphere (B): As the energy travels from its source to the target, it comes in contact with and interacts with the atmosphere it passes through. This interaction takes place a second time as the energy travels from the target to the sensor. 3. Interaction with the Target (C): Once the energy makes its way to the target through the atmosphere, it interacts with the target depending on the properties of both the target and the radiation. 4. Recording of Energy by the Sensor (D): After the energy has been scattered by, or

emitted from the target, a device known as sensor (remote - not in contact with the target) collects and records the electromagnetic radiation 5. Transmission, Reception and Processing (E): The energy recorded by the sensor is transmitted, often in electronic form, to a receiving and processing station where the data are processed into an image (hardcopy and/or digital). 6. Interpretation and Analysis (F): The processed image is interpreted, visually and/or digitally or electronically, to extract information about the target which was illuminated. 7. Application (G): The final element of the remote sensing process is achieved when we apply the information, we have been able to extract from the imagery about the target in order to better understand it, reveal some new information, or assist in solving a particular problem.

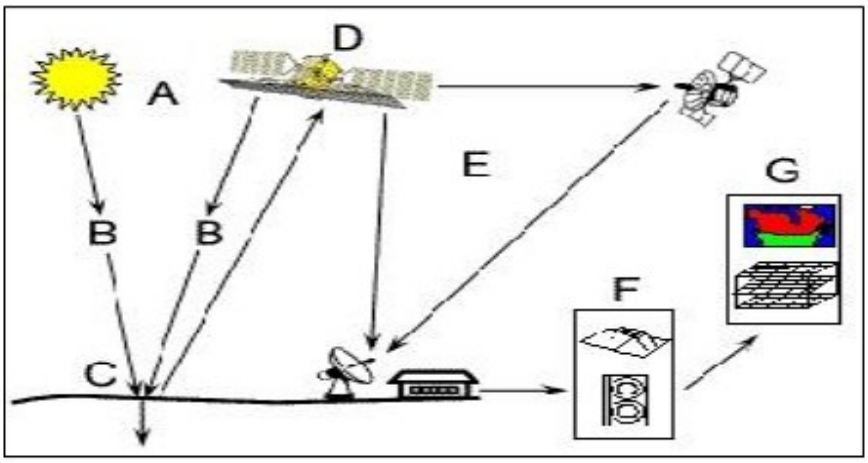


Fig 1: Process of Remote Sensing

The present investigation will be divided into following parts: -

Part 1: - Literature survey about the topic selected from various sources.

Part 2: - Study of plant diversity in selected forest hotspots of Nanded district.

Part 3: - Study of change in cropping pattern in and around selected forest hotspots of Nanded district of Maharashtra with the help of Remote sensing data.

Part 4: - Collection of soil samples from selected forest hotspots of Nanded district of Maharashtra.

Part 5: - Procurement of ethnomedicinal information about the plant species from available literature and from field visits in the selected area from the native populations.

Part 6: - Analysis of density and distribution of plant species using available GIS techniques along with statistical tools and modern software.

4. International and National status:

Present investigation is very important as it will be helpful for recording diversity, distribution and documentation of the forest plant species from selected forest hotspots of Nanded District. This information is very much helpful for the students and researchers for their research. Objective of the present research is to explore existed flora and assessment of their significance biodiversity in selected forest hotspots of Nanded district of Maharashtra.

5. Significance of the study:

An understanding of the distribution of plants and their species in a region plays an important role in elucidating the larger patterns of distribution of biodiversity. Present investigation will be very important as it will be helpful for plant diversity in selected forest hotspots of Nanded district of Maharashtra which will be more helpful for the students and researchers. Documentation of existing plant diversity selected forest hotspots in the study area from Nanded district of Maharashtra is important to determine existing resources and to set target for future improvements. Floras serve as the basic reference of the plant biota of an area; they are critical tools that serve botanists, conservationists, ecologists, foresters, gardeners, agronomists, researchers, and the public. The botanical exploration of the study area will be helpful to provide economically valuable information for societal need.

6.Structure of research work plan:

Time (Months)	Work
00-06	Review of literature
01-24	Field work/data collection
24-36	Data interpretation. Writing of thesis, Publication writing.

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